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OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

MEMORANDUM

SUBJECT: **Usage Metrics for Row Crops Estimated from Survey Data**

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Summary

This memo provides information on pesticide usage to better characterize risk assessment scenarios, results of risk assessments based on maximum label parameters, and potential risk management strategies. This memo, with the attached spreadsheets, summarizes the usage of 310 active ingredients on 19 row (= field) crops based on private market research surveys conducted between 2006 and 2010. The following metrics are presented in Appendix B:

For each chemical / row crop combination (Appendix B, Table 1)

- Percent of base acres treated using air or ground equipment, and
- Percent of base acres treated with granular or liquid formulations.

For each chemical / row crop / formulation / application method combination (Appendix B, Table 2)

- Percent of base acres treated
- Average number of applications
- Average application rate

For each separate application for each chemical / row crop / formulation / application method combination (Appendix B, Tables 3 and 4)

- Percent of acres receiving a given number of applications
- Cumulative percent of acres for each application

Introduction

The incorporation of "real-world" information improves the accuracy of risk assessments and ultimately results in high quality risk management decisions. An efficient way to accomplish this in OPP's risk assessments and risk management decisions is to increase the use of information in currently available pesticide surveys.

This document summarizes responses from private market surveys on pesticide use on 19 field (row) crops. The combined acreage for these row crops is approximately 742 million acres, or about 80 percent of the 922 million acres of the "land in farms" in the United States (USDA 2007).

BEAD recognizes that similar information would be useful for an expanded group of crops, especially the specialty crops (i.e., fruits and vegetables). Unfortunately, because of the reduced amount of information collected with the specialty crop surveys and the lack of access to raw survey data, BEAD currently cannot calculate comparable measures for these crops.

Use of Document – The information included herein should be particularly useful to both risk assessors and risk managers.

Ecological risk assessors should be guided by survey responses when identifying which scenarios to assess and in establishing an upper bound for input parameters (especially for formulation, application method, and number of applications) to the risk models. The use of most agricultural pesticides is driven by the presence of specific pests or groups of pests on the crop. When using a pesticide, growers purposefully select a formulation and method of application to target the susceptible life stage of the pest. For example, the survey responses show that all nematicides are applied using ground equipment, which is consistent the biology of soil-dwelling nematodes. Modeling the risk from the aerial application of a nematacide would be unrealistic.

Occupational exposure and risk assessors should find that the number of applications provides information about how frequently a given active ingredient is used during the growing season and thereby provide an indication of the duration of exposure to pesticide handlers. For example, potatoes frequently receive multiple applications of the fungicide chlorothalonil. Table 3 (Appendix B) shows that a third of

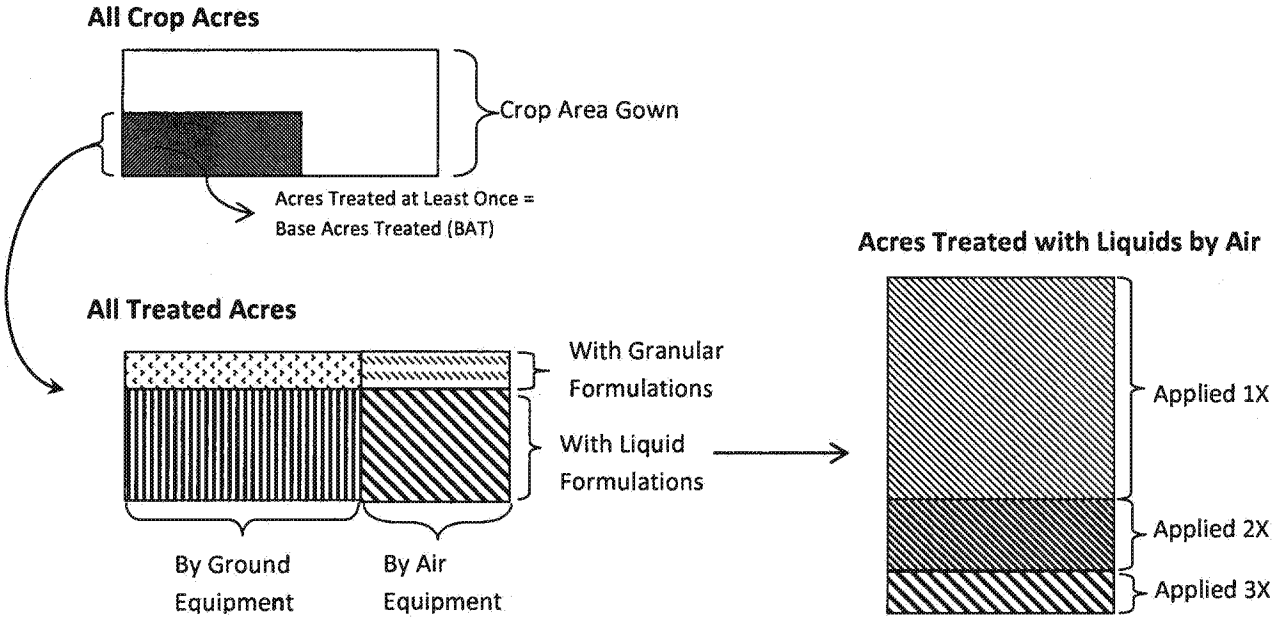
the acres treated with chlorothalonil by air receive more than 6 applications and that about 10 percent of the acres treated by air receive 10 or more applications.

Risk managers should find two uses for the information - first to evaluate how "close" (in terms of application rate, formulation, application method, and number of applications) the modeled risks are to reality. Second, should some sort of risk mitigation be necessary, the data in the tables may give a preliminary indication of the impacts related to changes in the summarized parameters (i.e., application rate, formulation, application method, and number of applications).

Organization of the Summarized Survey Data – Figure 1 illustrates the summarized data available for the 19 row crops. These data are presented in Appendix B. All tables are organized alphabetically by pesticide type, then alphabetically by active ingredient. Use of an active ingredient on a very small number acres (defined as a total of less than 2,500 acres treated over 5 years) are flagged with an asterisk in the tables.

This arbitrary value of acres treated (> 2,500 A treated over 5 years) is intended to indicate the "robustness" of the survey responses. There are other measures that could be used (e.g., sample size [= the number of survey respondents] or projected sample size [=sample size weighted to correct for biases and to extrapolate to the total crop growing population]). All of these measures give roughly equivalent results (i.e., less than 2,500 treated acres over five years are based on a very small number of survey responses). Should more specific information about the sample size and survey design be needed, it can be provided for a crop / chemical combination, upon request.

Figure 1. Example of a hypothetical crop treated by a single active ingredient.



Appendix B, Table 1. For Each Chemical – Row Crop Combination

% BAT Treated by Air
% BAT Treated by Ground
% BAT Treated with Granulars
% BAT Treated with Liquids

Appendix B, Table 2. For Each Chemical – Row Crop Combination

For Granulars Applied by Air
- % BAT with Granulars by Air
- Average Number of Application
- Average Application Rate (lbs AI / A)

For Liquids Applied by Air
- % BAT with Liquids by Air
- Average Number of Applications
- Average Application Rate (lbs AI / A)

For Granulars Applied by Ground
- % BAT with Granulars by Ground
- Average Number of Applications
- Average Application Rate (lbs AI / A)

For Liquids Applied by Ground
- % BAT with Liquids by Ground
- Average Number of Applications
- Average Application Rate (lbs AI / A)

Appendix B, Table 3. For Each Chemical – Row Crop Combination

For Granulars by Air
- % BAT for each Application
- Cumulative % BAT for each Application

For Liquids by Air
- % BAT for each Application
- Cumulative % BAT for each Application

[Low Acreage Flag when triggered]

Appendix B, Table 4. For Each Chemical – Row Crop Combination

For Granulars by Ground
- % BAT for each Application
- Cumulative % BAT for each Application

For Liquids by Ground
- % BAT for each Application
- Cumulative % BAT for each Application

[Low Acreage Flag when triggered]

Data Source, Scope, and Characterization

Data Source – Agrotrak® (GfK Kynetec, 2006 – 2010). Survey information in this database is considered proprietary by GfK Kynetec. *Following the contractual agreement between EPA/OPP and GfK Kynetec, only summary data, averaged over multiple years of surveys for the entire United States are presented in this document. More detailed information is available for EPA/OPP internal use upon request by OPP staff.*

Scope of Analysis –

- Years Included: 2006-2010
- Row Crops Included: Alfalfa, Barley, Canola (oilseed rape), Corn, Cotton, Dry Beans/Peas, Fallow, Pastureland, Peanuts, Potatoes, Rice, Sorghum (Milo), Soybeans, Sugar Beets, Sugarcane, Sunflowers, Tobacco, Wheat (Spring), Wheat (Winter).
- Active Ingredients Included: The complete listing of active ingredients reported in the surveys is given in Appendix 1 and includes 73 fungicides, 34 growth regulators, 132 herbicides, 87 insecticides, and 13 nematicides (for a total of 310 unique active ingredients). Some active ingredients may be used as more than one pesticide type (e.g., aldicarb is used both as an insecticide and as a nematicide) and are reported herein separately under each pesticide type.
- Application Method: Defined as aerial or ground. Values for the Agrotrak® variable "Who Applied" were grouped into these two categories as follows: Aerial (=custom aerial); Ground (= commercially applied, custom gound, farmer applied, not applicable, not collected, retailer applied).
- Formulation: Defined as the form that the active ingredient is applied to the crop, as either as a granular or as a liquid. Values for the Agrotrak® variable categories "Formulation" were grouped into these two categories as follows: Granular (=granular); Liquid (= dry flowable/WDG/SG, liquid, wettable powder).
- Parameters analyzed: All calculations use "base acres treated." See Figure 2 and the following text for further explanation.

Characterization of Surveys – When interpreting the summary results about chemical usage on row crops, the following two points should be considered:

Surveys are crop- and pesticide type-specific. It is important to note that while a specific grower may produce multiple crops, they are selected to participate in each crop survey independently. For example, a farmer in Iowa grows corn, soybeans, alfalfa, and winter wheat. The farmer may participate in one, or more than one crop survey. Information will be collected only about the target crop and not all crops grown on the farm. Further, survey questions are only asked about some (usually not all) types of pesticides used on that crop. Generally, this is because the overall use of particular pesticide types is rare or does not occur in some crops (e.g., nematicides in alfalfa). Table 1 shows the pesticide types included in each row crop survey.

Table 1. Pesticide Types Surveyed for Each Row Crop.

Crop	Fungicide	Growth Regulator	Herbicide	Insecticide	Nematicide
Alfalfa	-	-	X	X	-
Barley	-	-	X	-	-
Canola (rape)	-	-	X	X	-
Corn*	X	-	X	X	X
Cotton	X	X	X	X	X
Dry Beans/Peas	X	-	X	X	-
Fallow	-	-	X	-	-
Pastureland	-	-	X	-	-
Peanuts	X	-	X	X	X
Potatoes	X	X	X	X	X
Rice	X	-	X	X	-
Sorghum (Milo)	-	-	X	X	-
Soybeans	X	-	X	X	-
Sugar Beets	X	-	X	X	-
Sugarcane*	X	X	X	X	-
Sunflowers	-	-	X	X	-
Tobacco	X	X	X	X	X
Wheat, Spring	X	-	X	X	-
Wheat, Winter	X	-	X	X	-

* Corn: Fungicides were included in the surveys from 2007 to 2010 and nematacides were included for 2010 only. Sugarcane: Fungicides were included only in the 2010 survey.

Table produced by the following query from Agrotrak®: Filter (Year = 2006-2010), Across (Pesticide Type = All), Row (Crop = 19 field crops), Columns (Sample). Sample size values changed to presence/absence values.

Surveys are mainly conducted in areas where the greatest number of acres of a particular crop is grown and where the greatest production occurs. Field crop surveys are geographically focused on major production areas (generally targeting about 80% of the acreage / production) and are designed to capture representative practices that occur in a given crop. This is reflected in the distribution of growers by State shown in Table 2. Major crops that are produced widely across the US (e.g., alfalfa) require a broadly distributed sample, while crops produced in more restricted areas (e.g., sugarcane) require a more focused sample. This is also reflected in the survey sample sizes for each crop. Nearly 25,000 responses were tabulated for the 2006-2010 corn surveys, while several hundred responses were collected for the 2006-2010 surveys for sugarcane. In total, over 130,000 responses for the 2006-2010 surveys on the 19 row crops were summarized.

Table 2. States Included in Row Crop Surveys.

State	Alfalfa	Barley	Canola (rape)	Corn	Cotton	Dry Beans / Peas	Fallow	Pastureland	Peanuts	Potatoes	Rice	Sorghum (Milo)	Soybeans	Sugar Beets	Sugarcane	Sunflowers	Tobacco	Wheat, Spring	Wheat, Winter	Crops surveyed in each State
Alabama	-	-	-	X	X	-	-	X	X	-	-	-	X	-	-	-	-	-	-	5
Arizona	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	3
Arkansas	-	-	-	X	X	-	-	X	-	-	X	X	X	-	-	-	-	-	X	7
California	X	X	-	X	X	X	X	X	-	X	X	-	-	X	-	-	-	X	X	12
Colorado	X	X	-	X	-	X	X	X	-	X	-	X	-	X	-	X	-	-	X	11
Delaware	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	2
Florida	-	-	-	-	X	-	-	X	X	X	-	-	-	-	X	-	X	-	-	6
Georgia	-	-	-	X	X	-	-	X	X	-	-	X	X	-	-	-	X	-	X	8
Idaho	X	X	-	X	-	X	X	X	-	X	-	-	-	X	-	-	-	X	X	10
Illinois	X	-	-	X	-	-	-	X	-	-	-	X	X	-	-	-	-	-	X	6
Indiana	X	-	-	X	-	-	-	X	-	-	-	-	X	-	-	-	-	-	X	5
Iowa	X	-	-	X	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-	4
Kansas	X	-	-	X	X	-	X	X	-	-	-	X	X	-	-	X	-	-	X	9
Kentucky	X	-	-	X	-	-	-	X	-	-	-	-	X	-	-	-	X	-	X	6
Louisiana	-	-	-	X	X	-	X	X	-	-	X	X	X	-	X	-	-	-	-	8
Maine	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	1
Maryland	-	-	-	X	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-	3
Michigan	X	-	-	X	-	X	-	X	-	X	-	-	X	X	-	-	-	-	X	8
Minnesota	X	X	X	X	-	X	X	X	-	X	-	-	X	X	-	X	-	X	-	12
Mississippi	-	-	-	X	X	-	-	X	-	-	X	-	X	-	-	-	-	-	-	5
Missouri	X	-	-	X	X	-	-	X	-	-	X	X	X	-	-	-	-	-	X	8
Montana	X	X	-	-	-	X	X	X	-	X	-	-	-	X	-	-	-	X	X	9
Nebraska	X	-	-	X	-	X	X	X	-	X	-	X	X	X	-	X	-	-	X	11
Nevada	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
New Mexico	X	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X	4
New York	X	-	-	X	-	X	-	X	-	X	-	-	X	-	-	-	-	-	-	6
North Carolina	-	-	-	X	X	-	-	X	X	X	-	-	X	-	-	-	X	-	X	8
North Dakota	X	X	X	X	-	X	X	X	-	X	-	-	X	X	-	X	-	X	X	13
Ohio	X	-	-	X	-	-	-	X	-	-	-	-	X	-	-	-	X	-	X	6
Oklahoma	X	-	-	X	X	-	X	X	X	-	-	X	X	-	-	-	-	-	X	9
Oregon	X	X	-	-	-	-	X	X	-	X	-	-	-	-	-	-	-	X	X	7
Pennsylvania	X	X	-	X	-	-	-	X	-	X	-	-	X	-	-	-	X	-	-	7
South Carolina	-	-	-	X	X	-	-	X	X	-	-	-	X	-	-	-	X	-	-	6
South Dakota	X	X	-	X	-	-	X	X	-	-	-	X	X	-	-	X	-	X	X	10
Tennessee	-	-	-	X	X	-	-	X	-	-	-	-	X	-	-	-	X	-	X	6
Texas	X	-	-	X	X	X	X	X	X	X	X	X	X	-	-	X	-	-	X	13
Utah	X	X	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	4
Virginia	X	X	-	X	-	-	-	X	X	-	-	-	X	-	-	-	X	-	X	8
Washington	X	X	-	X	-	X	X	X	-	X	-	-	-	-	-	-	-	X	X	9
West Virginia	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	1
Wisconsin	X	-	-	X	-	-	-	X	-	X	-	-	X	-	-	-	-	-	X	6

State	Alfalfa	Barley	Canola (rape)	Corn	Cotton	Dry Beans / Peas	Fallow	Pastureland	Peanuts	Potatoes	Rice	Sorghum (Milo)	Soybeans	Sugar Beets	Sugarcane	Sunflowers	Tobacco	Wheat, Spring	Wheat, Winter	Crops surveyed in each State
Wyoming	X	X	-	X	-	X	X	X	-	-	-	-	-	X	-	-	-	-	-	7
States surveyed for each crop	29	13	2	34	15	12	16	37	8	17	6	12	28	9	2	7	9	9	25	

Table produced by the following query from Agrotrak®: Filter (Year = 2006-2010), Across (Crop = 19 field crops), Row (State = all), Columns (Sample). Sample size values changed to presence/absence values.

Survey Data Analysis – BEAD retrieved base acres treated data from the on-line propriety market research survey data base and calculated the values presented in Appendix B. Figure 2 shows the use of a pesticide on a hypothetical crop.

Figure 2. Calculations of Usage Statistics for a Hypothetical Active Ingredient and Crop (Not to scale).

Granulars Applied by Air 10,000 Acres treated a single time at 1.0 lb ai / A.	Granulars Applied by Ground 40,000 A treated a single time at 1.0 lb ai / A.	Untreated Crop Area 600,000 Acres
Liquids Applied by Air 85,000 Acres treated a single time at 1.0 lb ai / A.	Liquids Applied by Ground 200,000 Acres treated a single time at 0.75 lb ai / A.	
Liquids Applied by Air 10,000 Acres treated 2 times at 0.75 lb ai / A.	Liquids Applied by Ground 50,000 Acres treated two times at 0.5 lb ai / A.	
Liquids Applied by Air 5,000 Acres treated 3 times at 0.5 lb ai / A.		

Based on the values presented in the diagram above, the following general measures can be determined

- Total Crop Area Grown = 1,000,000 Acres (100% of Acres Grown)
- Untreated Crop Area = 600,000 Acres (60% of Acres Grown)
- Base Acres Treated (BAT) = 400,000 Acres (= the area treated at least once with the active ingredient = 40% of Acres Grown
- Total Acres Treated (TAT) = 470,000 Acres (= the sum of the area treated by each application times the number of applications = 335,000 Acres [single treatment] + 120,000 Acres [60,000 Acres treated twice] + 15,000 Acres [5,000 Acres treated three times)

- Percent Crop Treated (PCT) = 40% (= BAT / Total Crop Area Grown = 400,000 Acres / 1,000,000 Acres)

Following the organization of the tabular results section, values for this hypothetical example would be calculated as follows:

Appendix B, Table 1. For Each Chemical – Row Crop Combination

- % BAT Treated by Air = 27.5% (110,000 A / 400,000 A)
- % BAT Treated by Ground = 72.5% (290,000 A / 400,000 A)
- % BAT Treated with Granulars = 12.5% (50,000 A / 400,000 A)
- % BAT Treated with Liquids = 87.5% (350,000 / 400,000 A)

Appendix B, Table 2. For Each Chemical – Row Crop Combination

Granulars Applied by Air

- % BAT with Granulars by Air =2.5% (10,000 A / 400,000 A)
- Average Number of Applications = 1.0
- Average Application Rate = 1.0 lb AI / A

Liquids Applied by Air

- % BAT with Liquids by Air = 25% (100,000 A / 400,000 A)
- Average Number of Applications = 1.2 (weighted by %BAT = (85% * 1) + (10% * 2) + (5% * 3))
- Average Application Rate = 0.9 lb AI / A (Total lbs applied / TAT = 107,500 lbs / 120,000 TAT)

Granulars Applied by Ground

- % BAT with Granulars by Ground = 10% (40,000 A / 400,000 A)
- Average Number of Applications = 1.0
- Average Application Rate = 1.0 lb AI / A

Liquids Applied by Ground

- % BAT with Liquids by Ground = 62.5% (250,000 A / 400,000 A)
- Average Number of Applications = 1.2 (weighted by %BAT = (80% * 1) + (20% * 2)
- Average Application Rate = 0.6 lbs AI / A (Total lbs applied / TAT = 175,000 lbs / 300,000 TAT)

Appendix B, Table 3. For Each Chemical – Row Crop Combination

Granulars by Air

- 100% of the acres treated with granulars by air receive 1 application (10,000 A/10,000 A)

- Cumulative % BAT for each Application = 100% for 1 application

Liquids by Air

- 85% (85,000 A / 100,000 A) of the acres treated with liquids by air receive 1 application
- 10% (10,000 A / 100,000 A) of the acres treated with liquids by air receive 2 application
- 5% (5,000 A / 100,000 A) of the acres treated with liquids by air receive 3 application
- Cumulative % BAT = 85%, 95%, and 100% for 1, 2, and 3 applications, respectively.

Appendix B, Table 4. For Each Chemical – Row Crop Combination

Granulars by Ground

- 100% of the acres treated with granulars by ground receive 1 application
- Cumulative % BAT for each Application = 100% for 1 application

Liquids by Ground

- 80% (200,000 A / 250,000 A) of the acres treated with liquids by ground receive 1 application
- 20% (50,000 A / 250,000 A) of the acres treated with liquids by air receive 2 applications
- Cumulative % BAT = 80% and 100% for 1 and 2 applications, respectively.

Results

The summarized results for 310 active ingredients used on the 19 row crops are presented in the Appendix B. The following metrics are presented in Appendix B:

For each chemical / row crop combination (Appendix B, Table 1)

- Percent of base acres treated using air or ground equipment, and
- Percent of base acres treated with granular or liquid formulations.

For each chemical / row crop / formulation / application method combination (Appendix B, Table 2)

- Percent of base acres treated
- Average number of applications
- Average application rate

For each separate application for each chemical / row crop / formulation / application method combination (Appendix B, Tables 3 and 4)

- Percent of acres receiving a given number of applications
- Cumulative percent of acres for each application

Discussion

These tables include only the active ingredients reported in the surveys as being used on these field corps. There may be many other active ingredients registered on a particular field crop. Some reasons for the absences in the survey include the following:

- Growers did not choose to use a particular active ingredient on their crops during the years covered by the surveys
- Products containing the active ingredient may not be marketed by the manufacturer / distributor
- The active ingredient may be used so rarely that the survey sample was not large enough to detect its use
- The active ingredient may be used only in geographic areas not included in the suvey sample
- The active ingredient may not be a type of pesticide targeted in the crop survey
- Information about the active ingredient may be deliberately excluded from the survey

Lacking information to the contrary, it is reasonable to assume that the number of applications captured in the survey would not be exceeded by that for the unreported active ingredients. The assumption may be further refined by pesticide type that is to assume that the unreported active ingredients would not have a number of applications greater than the most frequently used active ingredient in a pesticide type. For example, assume an herbicide is registered on a surveyed field crop, but the number of applications is not reported in the survey. A high-end estimate of the maximum number of applications could be made by looking across the values for all other herbicides used on that crop and choosing the highest reported value. This could be further refined by looking at the characteristics of the active ingredients within the pesticide type (e.g., whether a fungicide is a protectant that requires frequent application, or a curative that is applied only after the disease appears).

Table 3 summarizes the greatest number of applications made to field crops by pesticide type categorized by the application method used and the form that the active ingredient is applied.

Table 3. Maximum number of applications by pesticide type, method, and form applied.

Pesticide Type	Application Method	Form Applied	Maximum Number of Applications	Crop (Active Ingredient)
Fungicides	Air	Liquid	16	Potato (chlorothalonil)
		Granular	1	Rice (copper sulfate)
	Ground	Liquid	16 (20)	Potato (chlorothalonil)
		Granular	1	Several crops (several a.i.s)
Growth Regulators	Air	Liquid	6	Cotton (mepiquat)
		Granular	--	--
	Ground	Liquid	6 (7)	Cotton (mepiquat)
		Granular	--	--
Herbicides	Air	Liquid	6	Cotton (glyphosate)
		Granular	3	Rice (molinate)
	Ground	Liquid	6	Cotton (glyphosate)
		Granular	3	Rice (molinate, quinclorac)
Insecticides	Air	Liquid	9	Cotton (cyfluthrin)
		Granular	1	Several crops (several a.i.s)
	Ground	Liquid	8 (14)	Cotton (acephate)
		Granular	4 (5)	Cotton (aldicarb)
Nematacides	Air	Liquid	--	--
		Granular	--	--
	Ground	Liquid	5	Potato (oxamyl)
		Granular	2	Cotton, peanut, tobacco (aldicarb)

Notes: Blank cells indicated that no survey data was reported for that combination of pesticide type, application method, and form applied. Numbers given in parentheses indicate the maximum number of applications based on low acreages (> 2,500 treated acres over 5 years) reported in the surveys.

This table illustrates several points about characteristics of the active ingredient affecting the number of applications. For example, the fungicide with the greatest number of applications is chlorothalonil, a protectant that requires frequent application to form a barrier against pathogens. Next, cotton requires the most frequent applications of growth regulators as this crop is a perennial with an indeterminate growth habit. Growers are using growth regulators to manage vegetative and reproductive growth of the plant to maximize yield. The herbicide with the greatest number of applications is glyphosate used on a herbicide tolerant crop. Most herbicides are used less frequently.

References

GfK Kynetec. 2006 - 2010. Agrotrak®. Information about GfK Kynetec is available at http://www.gfk.com/gfk-kynetec/industries/crop_protection_biotech_MarketShare_AgroTrak/index.en.html .

USDA. 2007. Census of Agriculture. United States Department of Agriculture.

Appendices

Appendix A. Chemicals reported in Row Crops (2006-2010) Surveys – Fungicides, Growth Regulators, Insecticides, Herbicides, and Nematacides

Appendix B. Pesticide Usage Metrics for Row Crops.

Table 1. Percent of base acres treated using air or ground equipment, and percent of base acres treated with granular or liquid formulations.

Table 2. Percent of base acres treated, average number of applications, and average application rate by formulation and equipment type.

Table 3. Percent of acres receiving a given number of applications by air.

Table 4. Percent of acres receiving a given number of applications by ground.

Appendix A. Chemicals reported in Row Crops (2006-2010) Surveys. **Chemicals marked with an asterisk occur in more than one pesticide type**. Data provided are for a specific pesticide type (e.g., glyphosate used as a herbicide) and not across all pesticide types (e.g., glyphosate used as a herbicide **or** as a growth regulator).

Fungicides

Acibenzolar
Azoxystrobin
Bacillus pumilis
Bacillus subtilis
Benomyl
Boscalid
Captan
Carboxin
Chloroneb
Chloropicrin*
Chlorothalonil
Coniothyrium minitans
Copper
Copper Hydroxide
Copper Oxychloride
Copper Oxychloride S
Copper Sulfate*
Cuprous Oxide
Cyazofamid
Cymoxanil
Cyproconazole
Dichloropropene*
Difenoconazole
Dimethomorph
Dodine
Etridiazole
Famoxadone
Fenamidone
Fenbuconazole
Fentin
Fluazinam
Fludioxonil
Fluoxastrobin
Flusilazole
Flutolanil
Flutriafol
Harpin Protein*
Hydrogen Peroxide
Hymexazol
Imazalil
Ipconazole
Iprodione
Mancozeb
Mandipropamid
Maneb
Mefenoxam
Metalaxyl
Metconazole
Metiram
Myclobutanil
Neem Oil
Phosphoric Acid
Propamocarb HCl
Propiconazole
Prothioconazole
Pyraclostrobin
Pyrimethanil
Quintozene
Streptomycin
Sulfur*
TCMTB
Tebuconazole
Tetraborohydrate
Tetraconazole
Thiabendazole
Thiophanate-methyl
Thiram
Triadimenol
Trifloxystrobin
Triticonazole
Vinclozolin
Zinc
Zoxamide

Growth Regulators

2,4-D*
2,4-DB*
6-Benzyladenine
Bacillus cereus
Butralin
Carbaryl*
Carfentrazone-ethyl*
Cyclanilide
Cytokinin
Decan-1-Ol
Dimethipin
Dimethylarsinic Acid
Diquat*
Diuron*
Endothal
Ethephon
Fatty Alcohols
Flumetralin
Flumiclorac*
Fluthiacet-methyl*
Gibberellic Acid
Glufosinate*
Glyphosate*
Harpin Protein*
IBA
Maleic Hydrazide
Mepiquat
Paraquat*
Pyraflufen-ethyl*
Sodium Chlorate
Sulfcarbamide
Sulfuric Acid*
Thidiazuron
Tribufos

Herbicides

2,4-D*
2,4-DB*
Acetochlor
Acifluorfen
Alachlor
Ametryn
Aminopyralid
Asulam
Atrazine
Benfluralin
Bensulfuron
Bentazone
Bispyribac
Bromacil
Bromoxynil
Butylate
Carfentrazone-ethyl*
Chloridazon
Chlorimuron
Chlorsulfuron
Clethodim
Clodinafop
Clomazone
Clopyralid
Cloransulam-methyl
Copper Sulfate*
Cyanazine
Cycloate
Cyhalofop
Desmedipham
Dicamba
Dichlorprop
Diclofop
Diclosulam
Difenzoquat
Diflufenzopyr
Dimethenamid
Dimethenamid-P
Diquat*
Diuron*
DSMA
EPTC
Ethalfluralin
Ethofumesate
Fenoxaprop
Florasulam
Fluazifop
Flucarbazone
Flufenacet
Flumetsulam
Flumiclorac*
Flumioxazin
Fluometuron
Fluroxypyr
Fluthiacet-methyl*
Fomesafen
Foramsulfuron
Glufosinate*
Glyphosate*
Halosulfuron
Hexazinone
Imazamethabenz
Imazamox
Imazapic
Imazapyr
Imazaquin
Imazethapyr
Iodosulfuron
Isoxaflutole
Lactofen
Linuron
MCPA
MCPB
Mecoprop
Mesosulfuron
Mesotrione
Metolachlor
Metolachlor-S
Metribuzin
Metsulfuron
Molinate
MSMA
Napropamide
Naptalam
Nicosulfuron
Norflurazon
Orthosulfamuron
Oxyfluorfen
Paraquat*
Pebulate
Pelargonic Acid
Pendimethalin
Penoxsulam
Phenmedipham

Picloram
Pinoxaden
Primisulfuron
Prometon
Prometryn
Propanil
Propazine
Propoxycarbazone
Prosulfuron
Pyraflufen-ethyl*
Pyrasulfotole
Pyrithiobac-sodium
Pyroxsulam
Quinclorac
Quizalofop
Rimsulfuron
Saflufenacil
Sethoxydim
Simazine
Sulfentrazone
Sulfosate
Sulfosulfuron
Sulfuric Acid*
Tebuthiuron
Tembotrione
Terbacil
Thiencarbazone-methyl
Thifensulfuron
Thiobencarb
Topramezone
Tralkoxydim
Tri-Allate
Triasulfuron
Tribenuron methyl
Triclopyr
Trifloxysulfuron
Trifluralin
Triflusulfuron

Insecticides

Abamectin*
Acephate
Acetamiprid
Aldicarb*
Azadirachtin
Azinphos-methyl
Bacillus thuringiensis
Bifenazate
Bifenthrin
Buprofezin
Carbaryl*
Carbofuran*
Chlorantraniliprole
Chlorethoxyfos
Chloropicrin*
Chlorpyrifos
Clothianidin
Copper Sulfate*
Cryolite
Cyfluthrin
Cyhalothrin-gamma
Cyhalothrin-lambda
Cypermethrin
Deltamethrin
Diazinon
Dichloropropene*
Dicofol
Dicrotophos
Diflubenzuron
Dimethoate
Dinotefuran
Disulfoton
Emamectin
Endosulfan
Esfenvalerate
Ethoprophos*
Etoxazole
Fenamiphos*
Fenpropathrin
Fenpyroximate
Fipronil
Flonicamid
Flubendiamide
Garlic Juice
Harpin Protein*
Hexythiazox
Imidacloprid
Indoxacarb
Kaolin Clay
Lindane
Malathion
Metaldehyde
Methamidophos
Methomyl
Methoxychlor
Methoxyfenozide
Methyl Parathion
Naled
Novaluron
Oxamyl*
Oxydemeton-methyl
Permethrin
Petroleum Oil
Phorate
Phosmet
Piperonyl Butoxide
Pirimicarb
Profenofos
Propargite
Pymetrozine
Pyrethrins
Pyriproxyfen
Rotenone
Spinetoram
Spinosyn
Spiromesifen
Spirotetramat
Sulfur*
Tebufenozide
Tebupirimphos
Tefluthrin
Terbufos
Thiacloprid
Thiamethoxam
Thiodicarb
Tralomethrin
Zeta-Cypermethrin

Nematicides

Abamectin*
Aldicarb*
Bacillus firmus
Carbofuran*
Chloropicrin*
Dichloropropene*
Ethoprophos*
Fenamiphos*
Harpin Protein*
Metam
Metam Potassium
Methyl Bromide
Oxamyl*